ENGINEERING EVALUATION AND COST ANALYSIS RESPONSE ACTION FOR OFF-SITE GROUNDWATER

WESTINGHOUSE FORMER FUEL CYCLE FACILITY SITE

FESTUS, MISSOURI

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ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	U.S. Code of Federal Regulations
COCs	Contaminants of concern
COPC	Contaminants of Potential Concern
DHSS	Missouri Department of Health and Senior Services
DNR	Missouri Department of Natural Resources
EE/CA	Engineering Evaluation and Cost Analysis
EPA	U.S. Environmental Protection Agency
FFCF	Former Fuel Cycle Facility
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Maximum Detection Limit
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NRC	Nuclear Regulatory Commission
PCE	Perchloroethylene (also known as tetrachloroethylene)
PQL	Practical Quantitation Limit
PWSD#5	Public Water Supply District #5
SARA	Superfund Amendments and Reauthorization Act
SVOC	Semi-Volatile Organic Compounds
TBC	To be considered
TCE	Trichloroethylene
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

On behalf of Westinghouse Electric Company, LLC. (Westinghouse), Cabrera Services, Inc. (CABRERA) has prepared this Engineering Evaluation and Cost Analysis (EE/CA) to evaluate potential response action alternatives to address the presence of volatile organic compounds (VOCs) that have been detected in groundwater in the vicinity of the Westinghouse Former Fuel Cycle Facility (FFCF or Site). The Site is located near the town of Hematite in Jefferson County, Missouri.

The area surrounding the Site is mainly suburban residential. At least 11,771 residents are served by public wells in the area, and an estimated 978 residents have private wells. The nearest public and/or private wells are located within 1/4 mile of the Site. In December 2001, VOCs, (primarily perchloroethylene (PCE), trichloroethylene (TCE), and their degradation by-products), were found in a private domestic well located on Westinghouse property northeast of the Site (private well #3). Subsequent testing found an additional seven wells to be affected, all of which are at residences located in the affected area located southeast of the Site. The affected wells are reportedly open to both the Jefferson City Formation and the underlying Roubidoux Formation. PCE, TCE and their degradation by-products are "hazardous substances" as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), State law and applicable regulations.

Section 2.0 presents the results of recent investigatory activities that were undertaken to better understand Site characteristics, Section 3.0 then evaluates four potential removal action alternatives that could be taken to address the groundwater impacts in the vicinity of the facility. The result of the EE/CA process is a recommendation for a removal action based on the evaluation of the alternatives considered. Preparation of this EE/CA fulfills CERCLA and the National Oil and Hazardous Substance Contingency Plan (NCP) requirements for documentation of the alternative selection process. The goal of this EE/CA is to develop an alternative that is protective of human health and the environment and is responsive to community concerns.

The removal action alternatives for the off-site groundwater conditions were developed after evaluating applicable technologies capable of protecting human health and the environment in light of the circumstances presented. The evaluated alternatives were the following:

- Alternative 1**:** No action.
- Alternative 2: Provision of bottled water and installation and monitoring of point-of-entry treatment systems.
- Alternative 3: Installation of deeper private wells.
- Alternative 4: Extension of existing public water supply.

The recommended alternative is the extension of the existing public water supply in the area (Alternative 4). Consistent with protocols established by the United States Environmental Protection Agency under the NCP, all four alternatives were evaluated with respect to effectiveness, implementability, cost, and other relevant factors. After a thorough evaluation of all relevant factors, Alternative 4, is the most cost effective remedy protective of human health and the environment.

1.0 INTRODUCTION

On behalf of Westinghouse Electric Company, LLC. (Westinghouse), Cabrera Services, Inc. (CABRERA) has prepared this Engineering Evaluation and Cost Analysis (EE/CA) to evaluate potential removal action alternatives to address the presence of volatile organic compounds (VOCs) that have been detected in the local aquifer in the vicinity of the Westinghouse Former Fuel Cycle Facility (FFCF).

2.0 SITE CHARACTERIZATION

Site characterization includes discussion of: the Site description and background information; previous removal actions; the source, nature, and extent of contamination; summary of analytical data; the Site conditions justifying a removal action; and a streamlined risk evaluation.

2.1 Site Description and Background

This section is divided into two parts: a general discussion of the entire FFCF (the "Site") and a discussion specifically about off-site groundwater conditions.

2.1.1 Site

The Site is located in the eastern portion of Missouri in Jefferson County near the town of Hematite. (Figure 1 Site Location Map.) It fronts the eastbound lane of Missouri State Road P, between the hills to the northwest and the terrace and floodplain of Joachim Creek to the southeast. The topography slopes gently to the southeast eventually blending with the alluvial floodplain deposits of the Joachim Creek, which runs along the southeastern edge of the Site property and eventually flows into the Mississippi River.

The area surrounding the Site is mainly suburban residential. Groundwater is widely used within four miles of the Site as the primary source of household water for the community. At least 11,771 people are served by public wells in the area, and an estimated 978 people are served by private wells. The closest wells are located within 1/4 mile of the Site.

The facility was opened in the mid-1950's by Mallinckrodt Chemical Works and through the mid 1970's was owned and operated by a variety of entities, including United Nuclear Corporation and Gulf Nuclear Fuels Company. Until the early 1970's, the site was heavily involved in producing uranium for the United States Navy and United States Department of Energy. In the Mid-1970's Combustion Engineering Inc. acquired the property and began commercial nuclear fuel production. Westinghouse purchased the facility in April 2000. There are currently no manufacturing operations at the Site.

Primary functions at the Site throughout its history have included the manufacture of uranium metal and uranium compounds from natural and enriched uranium for use as nuclear fuel. Specifically, operations included the conversion of uranium hexafluoride gas of various ^{235}U enrichments to uranium oxide, uranium carbide, uranium dioxide pellets, and uranium metal.

These products were manufactured for use by the federal government and government contractors and by commercial and research reactors approved by the Atomic Energy Commission. Research and development was also conducted at the Site, as were uranium scrap recovery processes.

2.1.2 Off-Site Groundwater Impacts

In December 2001, the Missouri Department of Health and Senior Services (DHSS) conducted annual radiological monitoring (gross alpha/gross beta) of four private wells near the Site. Samples were also collected for volatile organic analyses at the request of the Department of Natural Resources. Results of that sampling revealed that one of the private drinking water wells sampled by DHSS exhibited VOC concentrations, including tetrachloroethylene (PCE), and trichloroethylene (TCE), above drinking water standards. This well (i.e., Well #3) is located northeast of the FFCF at a residence situated on Westinghouse property and leased by Westinghouse. This well had been last sampled in 1996 for VOCs, and did not contain VOCs at that time. Once informed of this finding, Westinghouse and the Missouri Department of Natural Resources (DNR) conducted follow-up testing. In March 2002, Westinghouse tested an additional 20 wells, five of which were found to be impacted by VOCs, (bringing the total number of affected wells to six). In April 2002, DNR and DHSS sampled additional private wells, while Westinghouse conducted repeat sampling of those previously sampled. Analytical results of this sampling event in April showed no additional private wells were affected. In July 2002, the first round of quarterly sampling was conducted, and detectable levels of VOCs were found in two more wells, bringing the total number of affected wells to eight. Except for the well #3, all of the affected wells are at residences located in the affected area located southeast of the Site. Figure 2 shows the affected area.

The affected wells are all reportedly open to both the Jefferson City Formation and the underlying Roubidoux Formation. Hydrogeologic evaluations of the Site area *(Leggette, Brashears & Graham, Inc., November 2002)* have concluded that groundwater in the Jefferson City Formation has been impacted by the VOCs of interest, whereas groundwater in the deeper Roubidoux Formation generally has not.

Based on these findings, and in consultation with DNR, Westinghouse determined that a time-critical removal action was appropriate to mitigate potential risks to residents in the vicinity of the Site. Westinghouse prepared an Action Memorandum (*Action Memorandum, Former Fuel Cycle Facility, Off-site Groundwater, June 2002)* to document its response. Components of the Action Memorandum are discussed in Section 2.2.

2.2 Previous Removal Actions

Previous investigations are described in detail in the *Action Memorandum, June 2002*. Actions taken subsequent to those investigations are presented below.

Major components of the Action Memorandum that Westinghouse has implemented include the following:

- Mitigation of the public health concerns via well testing, installation of point-of-entry water treatment systems (i.e., activated carbon treatment units), as required and provision of bottled drinking water as required.

- Establishment of "sentinel or sentry wells", i.e., four wells installed near Site boundaries between potentially impacted groundwater and the community.

- Deep bedrock core drilling and geophysical testing to establish hydrogeologic conditions.

- Quarterly well monitoring of private wells in impacted communities and the sentinel wells.

- Geophysical analysis to provide additional detail for geologic and hydrogeologic information gathered during the coring and permeability testing.

In July 2002, the first round of quarterly sampling under the Action Memorandum was conducted and detectable levels of VOCs were found in two more wells. Activated carbon treatment systems were immediately installed at these two new locations, bringing the total of affected homes to eight.

2.3 Analytical Data

Analytical data resulting from the characterization study discussed in Section 2.2 are included in the *Interim Hydrogeologic Investigation to Support the Engineering Evaluation and Cost Analysis for Off-Site Groundwater, (Leggette, Brashears & Graham, Inc., November 15, 2002).* The results of the investigation showed that VOCs were present in the Jefferson Formation at one location from a depth of 95 feet to 105 feet below ground surface (bgs) at the BR4 location approximately 1400 feet downgradient of the plant. The Roubidoux and Gasconade Formations were not impacted in the drilling locations from this characterization effort. Groundwater in the Jefferson City and Roubidoux Formations was determined to flow to the east-southeast. Analytical data from the residential well sampling effort are provided in Appendix A.

2.4 Site Conditions Justifying a Removal Action

Section 300.415(b)(2) of the NCP provides several criteria for evaluating the need for and selection of removal actions. If conditions at a site satisfy the conditions of one or more of these criteria, the NCP indicates that a removal action may be appropriate. Conditions regarding off-site groundwater addressed in this EE/CA satisfy two of the these criteria, thereby, justifying the performance of a removal action:

- "Actual or potential exposure to nearby human populations, animals, or food chain from hazardous substances or pollutants or contaminants"

- "Actual or potential contamination of drinking water supplies or sensitive ecosystems"

Analytical monitoring results from the residential sampling program, March 2002 through July 2002, are presented in Appendix A. As noted above, this private water well sampling has revealed the presence of PCE, TCE, and their degradation products in groundwater in the vicinity of the Site. The presence of these constituents in these wells, if left unaddressed, could present a threat to public health, welfare, and/or the environment, thereby providing justification for a removal action.

2.4.1 Appropriateness of a Non-Time-Critical Removal Action

As established under the NCP, whenever a planning period of at least six months exists before on-site activities must be initiated, a non-time-critical removal action is deemed appropriate (40 CFR 300.415(b)(4)). In the current situation, because Westinghouse is providing point-of-entry treatment to homes, as needed under the June 2002 Action Memorandum, this planning period to evaluate removal alternatives in an EE/CA is appropriate. Nonetheless, site conditions still necessitate taking relatively prompt action to address off-site groundwater issues in the longer term. Moreover, the off-site groundwater issues discussed in this EE/CA can be addressed through the implementation of readily available and relatively non-complex, cost-effective solutions. In addition, each alternative discussed in this EE/CA can be implemented while the more comprehensive investigation at the FFCF Site is being undertaken as part of the RI/FS. As such, it is appropriate to address the off-site groundwater issues discussed in this EE/CA as a non-time critical removal action.

2.5 Streamlined Risk Evaluation

The streamlined risk evaluation discussion is presented in three sections: human health risks, ecological risks, and proposed cleanup levels.

2.5.1 Human Health Risks

The Streamlined Risk Evaluation is a unique type of evaluation that EPA developed for use in non-time-critical removal actions. The Streamlined Risk Evaluation is intermediate in scope between the limited risk evaluation undertaken in emergency situations and the conventional baseline assessment normally conducted for remedial actions, *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA/540-R-93-057, August1993) ("EE/CA Guidance"). In the streamlined assessment, the single human health exposure pathway of ingestion of impacted groundwater (i.e., current use scenario) was considered.

To better focus the streamlined risk evaluation, and in accordance with EPA guidance, Compounds of Potential Concern (COPCs) were identified. For the proposed removal action, COPCs are VOCs, including PCE, TCE, and their degradation by-products. Groundwater VOC data at each well were compared to Federal Maximum Contaminant Levels (MCLs) (EPA 2002 Edition of the Drinking Water Standards and Health Advisories, Summer 2002, EPA 822-R-02-038) and Missouri's Department of Natural Resources' MCLs (7/31/00). Compounds present at concentrations above the corresponding MCLs prior to treatment, were evaluated in the Streamlined Risk Evaluation, whereas COPCs present at concentrations below corresponding MCLs were not considered. Three wells did not have concentration of COPCs above MCL's. The remaining five wells had concentrations of COPCs above MCL's.

For purposes of this Streamlined Risk Evaluation, the exposure point concentration of each COPC in each well was conservatively taken as the maximum concentration of that constituent observed in any of the sampling of that well prior to treatment. As noted in EPA's guidance relating to Streamlined Risk Evaluations, where, as here, standards (*i.e.*, MCLs) for one or more COPCs are clearly exceeded, a removal action generally is warranted, and further quantitative assessment is not necessary. (See EE/CA Guidance, pp. 29-30). Based on this comparison, a non-time-critical removal action is appropriate.

2.5.2 Ecological Risks

Ecological risks are not considered because the only identified route of potential exposure is via contact with or ingestion of water from drinking water wells.

2.5.3 Proposed Cleanup Levels

Following the performance of response activities (i.e., when choosing an alternative other than the "no action" alternative), cleanup levels must meet ARARs to the extent practicable. In the context of this EE/CA, federal MCLs are chemical-specific standards that are most relevant and appropriate to this response action.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

This section of the EE/CA presents the development of removal action objectives specific to impacted off-site groundwater and potential exposure routes related to those conditions. The primary objective for this EE/CA is to prevent human health risks that may be posed by the use of groundwater impacted by VOCs in the vicinity of the Site. Evaluations of remedial actions for source abatement and hydraulic controls of impacted groundwater are beyond the scope of this EE/CA. These issues will be further evaluated in the context of implementing the Site-wide RI/FS Work Plan.

3.1 Statutory Limits

Authority for responding to releases or threats of releases of hazardous substances is addressed in Section 104 of CERCLA. CERCLA, Section 104 (c)(1), and the NCP, Section 300.415, addresses non-time-critical removal actions. It should be noted that statutory limits under CERCLA and the NCP regarding duration and funding apply only to removal actions undertaken by the federal government, and are not applicable to private party responses.

3.2 Scope and Purpose

The scope of the proposed removal action is to address groundwater impacted by VOCs in the vicinity of the Site where local residents use groundwater as their water supply. The purpose of the proposed removal action is to prevent the potential exposure to local residents from ingestion of, inhalation of, or direct contact with this impacted water.

3.3 Removal Action Schedule

The schedule for removal activities will be determined under the direction of Westinghouse with the approval of the DNR. The removal action schedule will be designed within a time frame that ensures adequate and timely protection of public health and the environment.

3.4 Proposed Remedial Activities

As noted above, Westinghouse currently is evaluating the Site pursuant to the procedures and schedules established in the RI/FS Work Plan. Future remedial steps for the Site will be implemented through the process identified in that Work Plan. The removal action selected within the scope of this EE/CA will, to the extent practicable under the circumstances, be consistent with any future remedial steps taken at the Site.

3.5 Applicable or Relevant and Appropriate Requirements

Applicable or Relevant and Appropriate Requirements (ARARs) are Federal and State human health and environmental requirements used to define the appropriate extent of site cleanup, identify sensitive land areas or land uses, develop response alternatives, and direct site cleanup. CERCLA and the NCP require that remedial actions comply with State ARARs that are more stringent than Federal ARARs, are legally enforceable, and are consistently enforced statewide. Although not directly applicable to removal actions under CERCLA, the NCP indicates that such actions should attain ARARs, to the extent practicable under the circumstances.

The NCP defines two ARAR components: (1) applicable requirements and (2) relevant and appropriate requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a site. State standards that may be applicable are only those that have been identified by the State in a timely manner, are consistently enforced, and are more stringent than Federal requirements. "Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive requirements under Federal and State environmental and facility siting laws that, while not directly "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the site so that their use is well suited to the particular site.

Other guidance "to be considered" (TBC) are Federal and State non-promulgated advisories or guidance that are not legally binding and do not have the status of potential ARARs (i.e., they have not been promulgated by statute or regulation). If there are no specific ARARs for a chemical or site condition, then guidance or advisory criteria may be identified and used to ensure the protection of human health and the environment.

Under the description of ARARs set forth in EPA guidance, State and Federal ARARs are categorized as chemical-specific (i.e., governing the extent of site remediation with regard to specific constituents and pollutants), location-specific (i.e., governing site features such as

wetland, floodplains, and sensitive ecosystems and pertaining to existing natural and manmade site features such as historical or archaeological sites), and action-specific (i.e., pertaining to the proposed site response actions and governing the implementation of the selected site cleanup approach).

Chemical-specific ARARs and TBCs for the FFCF Site are summarized in Table 3-1, location–specific ARARs and TBCs are summarized in Table 3-2, and action-specific ARARs and TBCs are summarized in Table 3-3. During the analysis of removal action alternatives in Section 5.0, each alternative is analyzed to determine its compliance with ARARs.

Table 3-1

Potential Chemical-Specific ARARs/TBCs

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirements	Status	Comment
Water Quality Criteria	CWA §304	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Potentially relevant and appropriate	May be relevant and appropriate, depending upon the circumstances.
National Primary Drinking Water Standards	40 CFR 141	Establishes health based standards (MCLs), monitoring requirements, and treatment techniques for public water systems.	Potentially applicable to public water supplies; potentially relevant and appropriate to groundwater cleanup	MCLs have been promulgated for certain of the COPCs.
National Secondary Drinking Water Standards	40 CFR 143	Establishes aesthetic-based (i.e., not health-based) standards for public water systems.	To be considered	Secondary drinking water standards do not apply to COPCs. May be action-specific to the extent the action could affect constituents subject to secondary drinking water standards.
Maximum Contaminant Level Goals (MCLGs)	40 CFR 141.50, 141.51, 141.52	Establishes non-enforceable drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety.	Potentially relevant and appropriate	MCLGs have been established for certain COPCs.
Safe Drinking Water Act	40 CFR 149	Sole source drinking water aquifer designation.	To be considered	Affected aquifer is not sole source aquifer.

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirements	Status	Comment
NPDES	40 CFR 122	Any pollutant-containing wastewater that is discharged to waters in the United States must obtain a discharge permit.	Potentially applicable	Applies to direct discharges; none of the alternatives include discharge to a water body.

Table 3-2
Potential Location-Specific ARARs/TBCs

Standard, requirement, criteria, or limitation	Citation	Description of Requirements	Status	Comment
None.				

Table 3-3
Potential Action-Specific ARARs

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirements	Status	Comment
Occupational Safety and Health Administration	29 CFR 1910.120	Establishes limits for worker exposures during response actions at CERCLA sites.	Potentially applicable	Potentially applicable to all alternatives for the protection of remediation workers.
Health and Safety Requirements for Construction Activities	29 CFR 1926	Establishes construction standards for workers.	Potentially applicable	Potentially applicable to all alternatives for the protection of remediation workers.
Resource Conservation and Recovery Act	40 CFR 260, et seq.	Regulates management of waste generated from water treatment systems (e.g., spent carbon) and other response activities.	Potentially applicable	Potentially applicable relative to evaluation and, if necessary, management of waste materials generated in water treatment and/or other selected response activities.
Missouri Statutes and Code of Regulations	260.350-260.430 10CSR 25-1.010	Regulates management of hazardous waste.	Potentially applicable	Potentially applicable to alternatives generating hazardous waste.
Missouri Well Construction Code	10 CSR 23-3	Provides Missouri requirements for the installation and abandonment of wells.	Applicable	Applicable to alternatives including the installation and abandonment of wells.
Missouri Solid Waste Law and Rules	260.350-260.430 10CSR 80-1.010	Regulates management of solid (non-hazardous) waste.	Potentially applicable	Potentially applicable to alternatives for solid waste disposal.

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Removal action alternatives should accomplish the identified cleanup objectives. Alternatives that meet cleanup objectives are further evaluated according to the broad criteria of effectiveness, implementability, and cost. For the purposes of this EE/CA, four removal action alternatives have been considered. These are presented below.

4.1 Alternative 1: No Action

Consideration of a "no action" alternative is typically required by the National Contingency Plan. Other potential alternatives will be compared to this "no action" baseline. This alternative would allow for hazardous chemical constituents to remain in place without any action being taken.

4.2 Alternative 2: Provision of Bottled Water and Point-of-entry Treatment

This alternative includes the installation and long-term maintenance of point-of-entry treatment systems in each of the homes that have impacted well water, plus an additional number of homes as a buffer area. In addition, this alternative provides bottled drinking water for all residences with impacted well water as well as those residences in the immediate neighborhood of the documented impacts. Under this alternative a quarterly monitoring program would be in effect as described in the DNR approved Action Memorandum, *Action Memorandum for Off-Site Groundwater, Westinghouse June, 2002*. If the results of monitoring indicated, additional point-of-entry treatment systems would be installed, as needed. For costing purposes, the assumption has been made that a total of six additional residential locations will require the installation of point-of-entry treatment systems.

4.3 Alternative 3: Installation of Deeper Private Wells

This alternative provides for the installation of private wells to replace the Well #3 and the 23 wells existing in the affected area (Figure 2). The deeper wells are assumed to be double-cased through the upper impacted Jefferson City aquifer and drilled to a depth of approximately 750 feet below ground surface, below the Roubidoux Formation. All of the existing residential drinking water wells are expected to be properly abandoned in accordance with Missouri Well Construction Code, *10 CSR 23-3*.

4.4 Alternative 4: Public Water Extension to Residents

This alternative includes the design and construction of an extension to the local public water supply system to the 24 homes located in areas where private wells have been affected by COPCs (i.e., affected area and well #3). All existing residential drinking water wells are expected to be properly abandoned in accordance with Missouri Well Construction Code, *10 CSR 23-3*.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The primary purpose of this removal action is to minimize the potential for human exposure to impacted groundwater found in the vicinity of the Site. The removal alternatives were evaluated using EPA's EE/CA Guidance.

This section evaluates the four removal alternatives identified in Section 4.0 based on their effectiveness, implementability, and cost in relation to Site-specific conditions, consistent with the previously referenced EE/CA Guidance. The removal alternatives are evaluated to ensure that they effectively protect human health and the environment and satisfy the removal action objectives defined for the media of concern.

5.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the removal action. The effectiveness and reliability of the removal alternatives are evaluated with respect to the VOCs and conditions at the Site. Among the factors considered in evaluating the effectiveness of an alternative is its overall protection of human health and the environment, its compliance with ARARs, and its short-term and long-term effectiveness.

5.1.1 Overall Protectiveness

Protective of Human Health and the Environment

This criterion addresses whether an alternative provides adequate protection of human health and the environment and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Under Alternative 1, the risk of potential human exposure from VOCs in the groundwater is not reduced or eliminated. COPCs would remain uncontrolled and, therefore, have the potential to allow for human exposure.

Under Alternative 2, potential human exposure from impacted groundwater would be essentially eliminated in that the groundwater is treated to remove VOCs. With effective maintenance, point-of-entry activated carbon systems would reduce VOC concentrations to non-detectable levels.

Under Alternative 3, potential human exposure would be similar to Alternative 2. With effective maintenance, deeper wells finished in the Roubidoux Formation would be expected to produce domestic water with no detectable COPCs.

Under Alternative 4, the risk of potential human exposure from Site-related VOCs in the groundwater is eliminated.

As described in the hydrogeologic analysis (*Leggette, Brashears & Graham, Inc., November 15, 2002*), the pumping of domestic wells in the affected area may act to pull the plume of VOCs in groundwater toward the area of pumping. Under Alternatives 1 and 2, this effect would continue. In addition, because the private domestic wells are open to both the Jefferson City Formation and the underlying Roubidoux Formation, these wells may act as conduits for

constituent migration into the Roubidoux. Through implementation of Alternative 3, these two issues would be addressed but, there is some, albeit minor, concern that the additional deep aquifer pumping under Alternative 3 could exacerbate the extent of impacted groundwater by creating a more pronounced downward gradient from the Jefferson City Formation to the Roubidoux Formation that would tend to cause VOCs to migrate into deeper groundwater. Under Alternative 4, groundwater pumping that could act to extend the areal extent of impacted groundwater would be halted and the private domestic wells that may serve as migration pathways for cross-contamination of aquifers would be eliminated.

(A) Protective of Workers During Implementation

Under Alternative 1, there is no risk of exposure to workers since no action would be taken.

Under Alternatives 2 and 3, there is a potential for worker exposure while installing the point-of-entry systems and drilling and installation of new wells. Potential worker exposure during these activities would be managed by design and implementation of a worker health and safety protection program.

Under Alternative 4, because the affected groundwater is deep in the bedrock and the overburden is not expected to be affected, the risk of exposure to workers while installing a water line extension would be minimal. Nonetheless, an appropriate health and safety plan would be implemented in connection with this alternative.

(B) Protective of the Environment

Alternatives 2, 3, and 4 are protective of the environment in that the replacement water source would not be impacted and thus would not affect the local environment (*i.e., irrigation, water for pets).* Institutional controls (*i.e., deed* restrictions) will be required for each of the alternatives in order to prevent private wells from being installed within the affected area. This EE/CA is focused on protection of human health from COPCs in groundwater in the vicinity of the Site. Issues relating to protection of the environment will be addressed more fully in subsequent actions undertaken pursuant to the RI/FS Work Plan.

(C) Compliance with ARARs

Alternative 1: Alternative 1 does not comply with chemical-specific ARARs as groundwater continues to be available to residents at concentrations above MCLs. There are no location-specific ARARs.

Alternative 2: Alternative 2 complies with chemical-specific ARARs. There are no location-specific ARARs. This alternative can be implemented in a manner compliant with action-specific ARARs.

Alternative 3: Alternative 3 complies with chemical-specific ARARs. There are no location-specific ARARs. This alternative can be implemented in a manner compliant with action-specific ARARs.

Alternative 4: Alternative 4 complies with chemical specific ARARS. There are no location specific ARARs. This alternative can be implemented in a manner compliant with action-specific ARARs.

5.1.2 Ability to Achieve Removal Objectives

EPA's EE/CA Guidance indicates that each removal action alternative should be evaluated to determine if it will achieve removal action objectives. Among the components to consider in this analysis are each alternative's long-term and short-term effectiveness, the level of permanence attained, and whether there will be any reduction of contaminant migration or volume.

Under Alternative 1, no upfront construction or remediation activities would be performed, and therefore, Alternative 1 would not cause additional short-term risk. Alternative 1 offers no long-term effectiveness, and the potential risks posed by using impacted groundwater remains unchanged.

Because of ease of implementation, Alternative 2 is effective in the short-term. By implementing this alternative, potential exposure to impacted groundwater can be quickly averted. However, it should be noted that short-term exposures already have been addressed through implementation of the June 2002 Action Memorandum (*e.g.*, installation and maintenance of point-of-entry treatment for affected residences). Because of design, construction, and permitting, Alternatives 3 and 4 cannot be implemented as quickly as Alternative 2.

No significant negative short-term effects will be caused by Alternatives 3 and 4. Under Alternative 3, workers will be performing all field work in compliance with a health and safety plan. No short-term impacts to construction workers or the community should be expected during implementation of Alternative 4 because all construction work will occur above the level of groundwater impacts.

In the long-term, Alternative 2 is effective only so long as the point-of-entry treatment systems are properly monitored and maintained. Alternative 3 would require some long-term monitoring and routine maintenance to ensure that the systems function properly and to demonstrate that the casing remains intact and deeper groundwater remains unaffected by Site-related constituents. Because the water supply would be part of an on-going public system subject to the institutional and administrative controls attendant to such systems, Alternative 4 does not rely on long-term maintenance and monitoring to be effective. Jefferson County Public Water Supply District #5 (PWSD #5) has an extensive monitoring program designed to control the water quality in the distribution system.

5.2 Implementability

The implementability criterion encompasses both the technical and administrative feasibility and the availability of required services and materials.

5.2.1 Technical Feasibility

Three important aspects of technical feasibility are (1) availability and reliability of the processes within a removal alternative; (2) construction and implementation timeframe; and (3) environmental conditions with respect to all relevant phases of the alternative. Implementation time and the period for beneficial results to be realized are critical factors in protecting public health and the environment.

The timeframe to undertake Alternative 1 is not an issue because no action is taken.

Alternatives 2 and 3, are technically feasible in terms of availability, proven reliability, and timeframe for receipt of necessary equipment and technologies. Alternative 4 is similarly ranked high in this category, with PWSD #5 indicating that extension of the water system is technically feasible. Alternatives 2, 3, and 4 have been proven in the industry to be reliable, and technical problems potentially leading to scheduling delays are not anticipated. Appropriately trained personnel are also readily available to perform required technical evaluations, design, and construction. Environmental impacts associated with any of these three alternatives would be minimal and potential worker and community safety concerns would be addressed through implementation of appropriate health and safety protection programs.

Alternatives 2, 3, and 4 would be consistent with any long-term remedial action to be taken at the Site through implementation of the RI/FS Work Plan. Alternative 4 is ranked highest in this category because, unlike Alternatives 2 and 3, hydraulic pumping will cease when private wells are closed.

5.2.2 Administrative Feasibility

The administrative feasibility factor evaluates those activities needed to coordinate with other offices, agencies, and the public. These concerns include approval from government agencies and interagency cooperation, procurement of off–site permits, compliance with policies and requirements, and public acceptance.

Alternatives 2 and 3 are administratively feasible while Alternative 3 requirements (i.e., permitting requirements for drilling through a contaminated zone) may cause schedule delays dependant upon the actual permit review times.

Through its communications with local officials, Westinghouse understands that Alternative 4 is administratively feasible. Local officials have expressed their interest in working with Westinghouse in providing an alternative water supply to affected residents. As noted above, PWSD #5 has advised Westinghouse that extension of the existing water line is technically feasible. In an effort to further the evaluation of Alternative 4, Westinghouse has authorized a detailed engineering evaluation by a local engineering firm to confirm the feasibility and cost of this alternative.

5.2.3 Availability of Services and Materials

As noted above, the necessary services and materials for Alternatives 2, 3, and 4, are readily available.

5.2.4 State and Community Acceptance

The State approved the decision to install active carbon filtration for point-of-entry treatment, Alternative 2, as an immediate action. Through careful monitoring and maintenance, Alternative 2 provides reduction in the levels of constituents below MCLs. However, there have been negative impacts with respect to community acceptance for this approach. Residents have complained of a pressure drop in their home water systems, fitting failures causing flooding in basements and damage to property, potential decrease in property value, inconvenience with the monitoring program, and the need for long term monitoring and maintenance requirements which disturbs the privacy in their homes.

Based upon discussions with community members and leaders, it appears that Alternative 4 would be accepted by the community. Community acceptance of Alternative 4 is enhanced by the benefit of improved fire protection for the homes in the affected area resulting from the installation of fire hydrants associated with the public water supply system.

5.3 Cost

The purpose of the EE/CA cost estimate is to compare the relative costs for various removal action alternatives. Relative capital costs and operational and maintenance costs are used rather than detailed estimates. The cost analysis is based on engineering judgment and each process is evaluated on its cost relative to the other alternative.

Under Alternative 1, there are no costs because no action will be taken.

Under Alternative 2, removal activities consist of upfront direct and indirect capital costs and substantial long-term costs. This alternative assumes that a total of fifteen point-of-entry systems will be installed. Additional costs for expanding this program are not included in these cost calculations.

Under Alternative 3, removal and disposal activities consist of upfront direct and indirect capital costs and includes long-term maintenance and monitoring costs.

Under Alternative 4, activities involve upfront direct and indirect capital costs and do not entail substantial long-term costs.

In the comparative cost analysis below, the costs under Alternatives 2, 3, and 4 are based on provision of an alternate water source (or point-of-entry treatment) for the Well #3 property and all 23 residences located in the affected area, (Figure 2). Although water samples obtained from many of the homes do not currently exceed MCLs as noted in Appendix A, it is possible that some will have exceedances in the future. This assumption reflects the cost of ensuring all residences are addressed that could potentially be affected by COPCs in groundwater.

Table 5-1

Comparative Cost Analysis

Description	Alternative 2 Activated Carbon Filtration and Bottled Water	Alternative 3 Drilling of New Deeper Private Wells	Alternative 4 Connection to Public Water Supply
Design	$0	$0	$74,218
Construction in Affected Area	$0	$0	$699,000
Drilling & Installation	$10,000[2]	$2,218,000[1]	$10,000[2]
Well Abandonment	$0	$55,200	$55,200
Activated Carbon Filtration Systems, monthly monitoring and bottled water	$911,106	$0	$0
Periodic Monitoring over 30 years	$1,052,250	$429,180[3]	$84,180[3]
Bottled water for neighbors – 30 years	$786,931	$0	$0
Total Costs (Gross)	**$2,760,287**	**$2,702,380**	**$922,598**
Total Costs – Net Present Worth[4]	**$1,149,520**	**$2,283,396**	**$818,388**

Note: 1 – Drilling and installation includes that required for private drinking water wells at 24 locations in the affected area, and one additional monitoring well.

2 – Drilling and installation for an additional monitoring well.

3 – Monitoring assumes that 2 monitoring wells will be included (one of which is planned in the RI/FS work plan).

4 – Net Present Worth analysis utilizes a 7% discount factor.

5.4 Summary of Removal Action Alternatives

This section summarizes the results of the analysis of each removal action for Alternative 1 through 4. Each removal action alternative is evaluated for its effectiveness, implementability, and relevant cost.

5.4.1 Alternative 1 in Summary

- Low rank in effectiveness with respect to both short-term and long-term human health protection.
- Low rank because this alternative would not comply with ARARs.
- Low rank for public acceptance.
- High rank for cost in that this "no action" alternative cost is the least expensive approach considered.

5.4.2 Alternative 2 in Summary

- High rank in short-term effectiveness and medium rank in long-term effectiveness. Although this alternative will provide both short and long-term human health protection, the long-term effectiveness ranking is reduced because this alternative relies heavily upon careful long-term monitoring and maintenance of the installed systems. It also potentially allows the expansion of the plume of VOC-impacted groundwater, both laterally in the Jefferson City Formation due to domestic well pumping and vertically, due to potential cross-contamination of the deeper Roubidoux Formation.
- Medium rank for compliance with ARARs insofar as this alternative will meet MCLs to the extent that the installed systems are properly maintained.
- Low rank in implementability with respect to long-term monitoring and maintenance of point-of-entry treatment systems.
- Low rank in cost comparison because this alternative entails high long term monitoring and maintenance.

5.4.3 Alternative 3 in Summary

- Medium rank in short-term effectiveness because of longer time needed for implementation. Assuming proper installation and maintenance, high rank in long-term human health protection.

- Medium rank for compliance with ARARs to the extent that the deeper wells are properly maintained and monitored.

- Low to medium rank in implementability with respect to technical and administrative feasibility. There is some concern that this approach could cause further spread of VOCs in groundwater.

- Low rank for cost in that Alternative 3 is more costly than Alternative 4.

5.4.4 Alternative 4 in Summary

- Medium rank in short-term effectiveness because of longer time needed for implementation. However, this ranking is mitigated due to the existing point-of-entry treatment systems already installed in affected residences pursuant to the June 2002 Action Memorandum.

- High rank in long-term human health protection. This alternative also fully addresses long-term concerns about the role of the private domestic wells in potentially spreading the lateral and vertical extent of VOCs in groundwater.

- High rank in implementability with respect to technical and administrative feasibility. Alternative provides added community benefits related to fire protection.

- High rank for cost insofar as it is the least expensive option (disregarding the "no action" alternative).

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The purpose of the comparative analysis is to identify the advantages and disadvantages of the alternatives when compared with each other, based on the detailed analysis described in Sections 4 and 5. This comparative analysis allows identification of items that can be evaluated by decision-makers during the final selection of a proposed alternative.

Table 6-1 summarizes the comparative analysis of Alternatives 2 through 4 based on effectiveness, implementability, and cost.

Parameter	Alternative 2	Alternative 3	Alternative 4
Effectiveness			
• Protects human health and environment	Protective	Protective	Protective - permanent
• Complies with ARARs	Yes	Yes	Yes
• Provides long term protection	Yes (with long-term monitoring)	Yes (with long-term monitoring)	Yes
• Provides short term effectiveness	Yes	No	No
• Reduces toxicity, mobility, volume	Yes (with controls)	No	No
• Time to achieve protection	Immediate	6 months	12 months
Implementability			
• Technical feasibility	Feasible	Feasible	Feasible
• Administrative feasibility			
- Government approval	Only as an immediate solution.	No	Yes
- Public acceptance	Only as an immediate solution, issues with fittings failure.	Unknown	Yes, preferred alternative.
Cost	Upfront direct and indirect capital costs and substantial long term monitoring and maintenance costs.	Upfront direct and indirect capital costs and long-term monitoring costs.	Upfront direct and indirect capital costs and long-term monitoring costs.

With respect to effectiveness, Alternative 4 is the most effective alternative to avoid human health exposures to affected groundwater in the long-term. This alternative provides the most permanent alternative to the use of impacted private groundwater wells and complies with ARARs. The use of a public water supply is controlled and managed by the institutional controls attendant to such system.

In this alternative, it is anticipated that further monitoring of the contaminant plume will be necessary. Upon provision of public water to the affected area, long term monitoring of three (3) select remaining private wells in the area will continue. Several additional monitoring wells are also expected to be installed as part of the RI/FS that will provide information to assess contaminant migration. These wells are expected to be sampled periodically until a long term monitoring program has been established for the site.

Alternative 2 provides treatment of constituents that remove COPCs from groundwater, but the rate of this removal is low enough so as not to meaningfully affect the mass or extent of VOCs in groundwater. Furthermore, there is some concern that pumping of domestic wells can and, perhaps has in this instance, caused the plume of VOCs to be pulled toward the southeast. In addition, the domestic wells may be a conduit of cross-contamination between the Jefferson City and Roubidoux Formations. Because Alternative 2 relies on long-term maintenance and monitoring, its effectiveness is considered to be less than that of Alternatives 3 and 4. Although Alternative 3 also prevents long-term human health risks by eliminating exposure to impacted groundwater, this alternative has the potential to cause further migration of impacted groundwater. Alternative 3 also requires more long-term monitoring and maintenance than does Alternative 4.

With respect to implementability, Alternative 2 is technically feasible but is difficult to sustain because of the necessary long-term surveillance and monitoring of point-of-entry groundwater treatment systems. Additionally, Alternative 3 involves long-term monitoring and as-needed repair/replacement to ensure that the integrity of the well casing through the Jefferson City Formation is maintained and that cross-contamination of the aquifers does not occur in the future. Conversely, Alternative 4 is technically and administratively feasible by following proper protocols and applicable guidance. Based upon input Westinghouse has received from governmental officials and members of the community, Alternative 4 also is likely to receive the most public acceptance. Therefore, Alternative 4 outweighs all other alternatives with respect to implementability.

With respect to relative total costs, Alternatives 2 and 3 are similar. Costs for Alternative 2 are based upon a total of 14 point-of-entry systems being installed, which may or may not be an accurate estimate. In addition, these costs are estimates and can be affected by unforeseen events and issues. Also, monitoring and maintenance costs in Alternatives 2 and 3 were projected out for 30 years according to EPA guidance. The true time frame of the future surveillance and maintenance costs inherent under Alternatives 2 and 3 are not capable of further definition, but the time frames could well exceed current expectations.

Although least costly, Alternative 1 will not be effective in protecting human health, will not attain ARARs, and will not meet removal action objectives for the Site. While easily

implementable from a technical standpoint, it may not be acceptable to governmental officials or local residents.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on the results of the comparison of alternatives in Section 6.0, the recommended Removal Action Alternative is Alternative 4. This alternative was selected as the most appropriate under the circumstances for the following reasons: (1) it is the most reliable alternative for protecting human health; (2) it can be implemented with limited technical difficulty; (3) it is the most permanent alternative; (4) it is expected to receive favorable public and governmental acceptance; (5) it is a cost-effective solution; and (6) it is consistent with and does not conflict with future planned response activities at the Site.

8.0 EVALUATION OF POST-REMOVAL SITE CONTROL ACTIVITIES NECESSARY TO SUSTAIN THE INTEGRITY OF THE REMOVAL ACTION

Limited post-removal Site control activities may be necessary to sustain the integrity of the selected removal action.

9.0 REFERENCES

EPA 1993 *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, EPA 540-R-93-057, August 1993.

Leggette, Brashears & Graham, Inc., November 15, 2002, *Interim Hydrogeologic Investigation to Support the EE/CA for Response Actions for Impacted Off-Site Groundwater*

Westinghouse 2002a *Action Memorandum for Off-Site Groundwater, Westinghouse,* June 2002

Appendix A

Analytical Results for Residential Sampling

Appendix A: Analytical Data, Residential Well Sampling

		Well #3							Well #15	Well #6
Parameter	**MDL *(ug/l)***	4-Dec-01[4]	8-Jan-02[4]	11-Jan-02[2]	14-Feb-02	17-Apr-02[5]	17-Apr-02	8-Aug-02	8-Aug-02	8-Aug-02
chloroethane	0.35	ND	3.2	3.2	ND	ND	2	3.2	ND	ND
1,1,1-trichloroethane	0.42	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethane	0.4	81	61	62	ND	32.8	31	40	ND	ND
1,2-dichloroethane	0.41	0.6	ND	ND	ND	ND	ND	0.59	ND	ND
1,1-dichloroethene	0.21	14	12	12	ND	7.5	8.5	13	ND	ND
cis-1,2-dichloroethene	0.49	230	190	200	1.4	113	100	130	0.52	ND
trans-1,2-dichloroethene	0.25	0.8	0.6	0.54	ND	ND	ND	ND	ND	ND
tetrachloroethene	0.36	300	260	240	30	150	150	110	ND	ND
trichloroethene	0.32	430	340	330	21	179	180	150	ND	0.74
vinyl chloride	0.36	31	19	25	ND	13.7	12	17	ND	ND

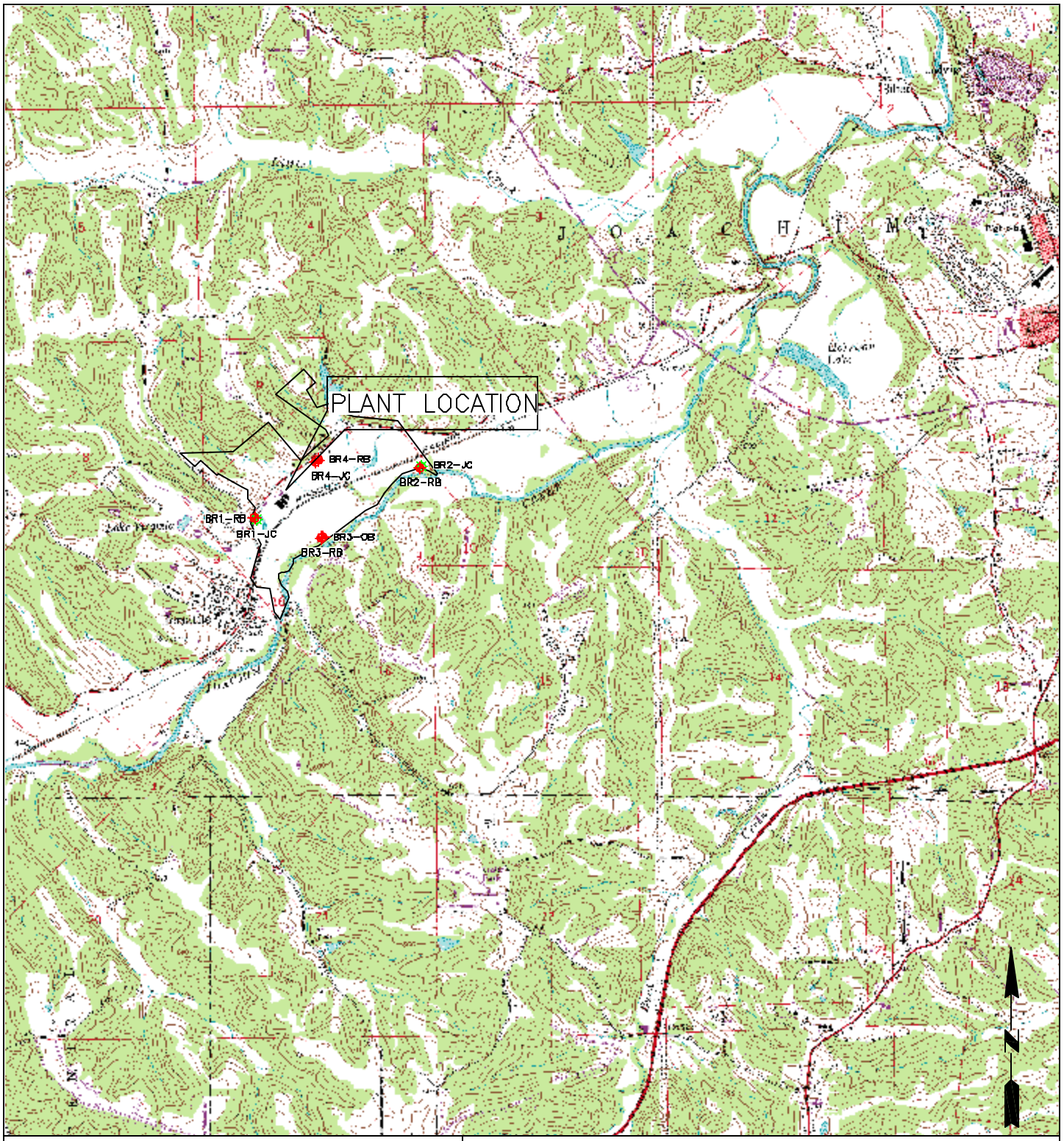
		Well #19						Well #17		
Parameter	**MDL *(ug/l)***	18-Mar-02	3-Mar-02[4]	25-Mar-02	17-Apr-02[3]	17-Apr-02	8-Aug-02	18-Mar-02	6-May-02	18-Jul-02
chloroethane	0.35	16	ND	18	31	32	20	ND	ND	ND
1,1,1-trichloroethane	0.42	ND	ND	ND	0.72	0.77	0.62	ND	ND	ND
1,1-dichloroethane	0.4	89	244	99	180	160	90	4	5.3	6.7
1,2-dichloroethane	0.41	1.3	3.4	1.5	ND	ND	1.6	ND	ND	ND
1,1-dichloroethene	0.21	48	121	57	80	73	39	1.7	2.4	2.9
cis-1,2-dichloroethene	0.49	450	1120	490	860	870	410	14	19	23
trans-1,2-dichloroethene	0.25	1.7	4.9	2	3.5	3.7	ND	ND	ND	ND
tetrachloroethene	0.36	180	376	230	330	330	160	4.5	5.9	7
trichloroethene	0.32	1100	2880	1300	2100	2200	720	29	40	49
vinyl chloride	0.36	41	190	52	60	56	54	ND	ND	ND

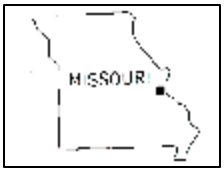
		Well #7			Well #16			Well #18		
Parameter	**MDL *(ug/l)***	18-Mar-02	17-Apr-02	18-Jul-02	28-Feb-02	15-Apr-02	18-Jul-02	18-Mar-02	16-Apr-02	8-Aug-02
chloroethane	0.35	ND	ND	ND	ND	ND	ND	1	0.57	4.4
1,1,1-trichloroethane	0.42	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethane	0.4	ND	ND	ND	5.6	5.1	14	10	8	29
1,2-dichloroethane	0.41	ND	ND	ND	ND	ND	ND	ND	ND	0.52
1,1-dichloroethene	0.21	2.8	2.4	ND	2.5	2.3	6.8	6.2	2.7	14
cis-1,2-dichloroethene	0.49	ND	ND	0.8	17	16	27	33	27	77
trans-1,2-dichloroethene	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND
tetrachloroethene	0.36	ND	ND	ND	12	10	19	35	18	35
trichloroethene	0.32	ND	ND	ND	44	39	50	81	60	190
vinyl chloride	0.36	ND	ND	ND	ND	ND	2.5	0.68	ND	2.3

Notes: *all results are reported in ug/l*

(1) - sample collected inside of residence
(2) - sample collected outside of residence
(3) - duplicate sample
(4) - DHSS sample results
(5) - MDNR sample results

Figures





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SCALE IN FEET

SOURCE:
U.S.G.S. TOPOGRAPHIC MAP
FESTUS, MISSOURI
7.5 MINUTE QUADRANGLE

WESTINGHOUSE ELECTRIC COMPANY
HEMATITE, MISSOURI FACILITY
HEMATITE, MISSOURI

PLANT LOCATION MAP AND DRILLING SITES

DATE	REVISED

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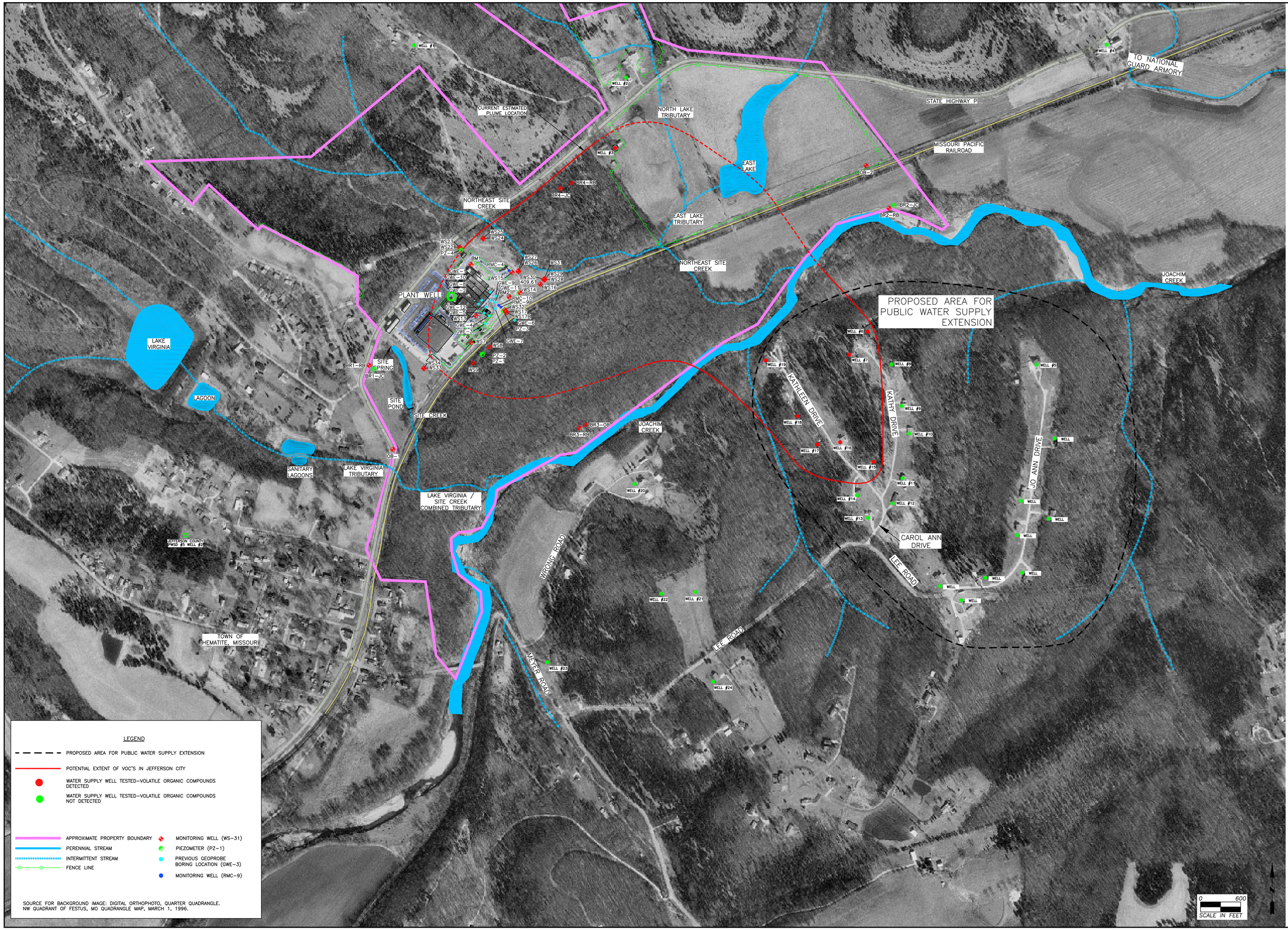
FILE:	12WWP02C.dwg	DATE: OCTOBER 2002	FIGURE: 1



LEGEND

- PROPOSED AREA FOR PUBLIC WATER SUPPLY EXTENSION
- POTENTIAL EXTENT OF VOC'S IN JEFFERSON CITY
- WATER SUPPLY WELL TESTED–VOLATILE ORGANIC COMPOUNDS DETECTED
- WATER SUPPLY WELL TESTED–VOLATILE ORGANIC COMPOUNDS NOT DETECTED
- APPROXIMATE PROPERTY BOUNDARY
- PERENNIAL STREAM
- INTERMITTENT STREAM
- FENCE LINE
- MONITORING WELL (WS–31)
- PIEZOMETER (PZ–1)
- PREVIOUS GEOPROBE BORING LOCATION (GWE–3)
- MONITORING WELL (RMC–9)

SOURCE FOR BACKGROUND IMAGE: DIGITAL ORTHOPHOTO, QUARTER QUADRANGLE. NW QUADRANT OF FESTUS, MO QUADRANGLE MAP, MARCH 1, 1996.

WESTINGHOUSE ELECTRIC COMPANY

HEMATITE FUEL MANUFACTURING
FESTUS, MISSOURI

ENGINEERING EVALUATION AND COST ANALYSIS – RESPONSE ACTION FOR OFF–SITE GROUNDWATER

FILE: 12WP02G.dwg | DATE: NOVEMBER 2002 | FIGURE: 2

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